

# LOMANDRA OREOPHILA (LOMANDRACEAE) — A NEW SPECIES IN THE *L. MICRANTHA* GROUP

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## ABSTRACT

Conn, Barry J. & Quirico, Anna-Louise. *Lomandra oreophila* (Lomandraceae) — a new species in the *L. micrantha* group. *Muelleria* 8(2): 123–132 (1994). — An evaluation of the morphological variation within *Lomandra micrantha* revealed that the taxon represented by *Lomandra micrantha* var. *sororia* (F.Muell. ex Benth.) H. Williamson should be regarded as a distinct species. Since the epithet '*sororia*' is already occupied (*L. sororia* (F. Muell. ex Benth.) Ewart), the new name *L. oreophila* Conn & Quirico is here provided. Although infraspecific variation within *L. micrantha* suggested that redefinition of the subspecific taxa may be necessary, the morphological characters used here were not sufficiently robust to clarify completely the infraspecific variation of this species.

## INTRODUCTION

During the preparation an account, by one of us (BJC), of the genus *Lomandra* for the *Flora of Victoria* project (Conn, *in press*), it became evident that the current circumscription of *L. micrantha* (Everett 1986, Lee & Macfarlane 1986) did not deal adequately with the infraspecific variation. In particular, *L. micrantha* subsp. *teretifolia* in Victoria was difficult to distinguish from *L. micrantha* subsp. *micrantha*, and the inclusion of *L. micrantha* var. *sororia* (F.Muell. ex Benth.) H. Williamson under synonymy with *L. micrantha* subsp. *tuberculata* Everett appeared to be incorrect. A detailed multivariate morphometric analysis was used to determine: (1) the status of the currently recognised infraspecific taxa of *L. micrantha*, and (2) the status of *L. micrantha* var. *sororia*.

## METHODS AND PRESENTATION

These investigations have been based on herbarium material of *Lomandra micrantha* s. lat. as held at MEL, NSW and PERTH (abbreviations as designated in Holmgren *et al.* 1990) and limited field studies. As a comparison, it would have been useful to have included *L. drummondii* in the analyses, but insufficient material was available of this taxon. One hundred and thirty collections were used for the numerical analyses.

The distribution summary and the citation of specimens examined for *L. oreophila* are grouped according to Conn (1992 & 1993). Inflorescence terminology follows Briggs & Johnson (1979).

## CHARACTERS

The morphological features used in the analysis of *L. micrantha* (s. lat.) are listed below, together with the alphabetic code used in figure 2. These features include those used by Everett (1986) and Lee & Macfarlane (1986).

1. Leaf shape (see note below)(LS)
2. Leaf length (mm)(LL)
3. Leaf width (mm)(LW)
4. Leaf base length (Sheath)(mm)(see note below)(LBL)
5. Leaf twist (present or absent)(LT)

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6. Inflorescence axis surface (scape)(see note below)(BU)
7. Inflorescence axis surface projections (see note below)(IB)
8. Inflorescence length (scape plus rachis)(mm)(IL)
9. Inflorescence length to leaf length ratio(ILL)
10. Scape (exposed or hidden by leaf-bases)(S)
11. Tepal length (mm)(TW)

Character 1 (leaf shape) is a 4-state variable, characters 5 (leaf twist), 6 (inflorescence axis surface) and 10 (scape) are 2-state variables, and character 7 (inflorescence axis surface projections) is a 3-state variable. All other characters (characters 2-4, 8, 9 & 11) were absolute measurements (averaged) on a continuous scale, and these are quantitative variables. It is assumed that these quantitative characters are generally self-explanatory. However, some of these, together with the 2-, 3- and 4-state characters are further discussed below.

**Leaf shape:** this character describes the cross-sectional shape of the leaves. It was scored as (0) flat, (1) plano-convex, (2) concavo-convex, or (3) semi-terete or terete. Flat leaves had both the abaxial and adaxial surfaces flat; plano-convex leaves are semi-circular (in cross-section), with the abaxial surface convexly curved (in cross-section) and the adaxial surface  $\pm$  flat; concavo-convex leaves have the abaxial surface convex (in cross-section) and the adaxial surface concave (in cross-section). Semi-terete or terete leaves have been treated as one category because of the difficulty of consistently distinguishing between these two leaf shapes. Although most leaves can be classified as one of the above leaf shapes, an occasional leaf may be intermediate between some of these categories. Therefore, the cross-sectional shape of three to five leaves was recorded and the most frequent shape was used in the analysis.

**Leaf base length (Sheath)(mm):** since the sheath is frequently torn and/or shredded, it is frequently difficult to measure. Therefore, although this character is probably of taxonomic value, its measurement was not always made with confidence. This character is usually easier to measure on living material than on herbarium specimens.

**Leaf twist:** this character describes the presence or absence of a longitudinal twist in the leaves; (0) not twisted, (1) twisted. Similar to leaf shape (see above), occasional leaves may not be twisted on plants that are otherwise characterised by leaves that are twisted. Therefore, the most common character-state was used in the analysis.

**Scape:** the scape is either enclosed by the basal leaf sheath and hidden, or it extends beyond the leaf sheath and is clearly visible. It was scored as (0) scape exposed, (1) scape hidden.

**Inflorescence axis surface (scape)(mm):** the surface of the scape is either smooth or papillose to warty (tuberculate)(refer next character, below). The length of the surface projections was measured (mm). When the surface was smooth it was recorded as 0 mm long. This character was treated as a continuous quantitative character.

**Inflorescence axis surface projections:** this character describes the type of surface projections on the inflorescence axis (scape). It is scored as (0) projections absent and so axis smooth, (1) papillae present, (2) tubercles present.

#### DATA ANALYSIS

Analyses were carried out using the PATN pattern analysis package (Belbin 1987, 1989). The data were standardised by range. Gower metric association measures between individual collections were submitted to ordination and clus-

tering techniques to assist in the interpretation of morphological patterns within the data. Ordination by Multidimensional Scaling (MDS) was used in this study. The linear correlation between each of the morphological characters and the axes in the MDS ordination space was investigated using principal axis correlation. Correlation coefficients ( $r$ ) were calculated for each character and these quantified the significance of the association. The direction of the correlation indicated the usefulness of the characters to differentiate the various taxa in the analysis. Clustering of the morphometric data using the fusion criterion of unweighted pair-group method using arithmetic averages (UPGMA) was carried out for comparison with the ordination results. Cramer association values ( $V$ ) were calculated for each of the characters. As for the correlation coefficients, the Cramer values also quantified the usefulness of each character. The rationale for the use of these multivariate techniques is provided by Belbin (1987, 1989) and Crisp (1991).

## RESULTS

### MORPHOLOGICAL VARIATION WITHIN *LOMANDRA MICRANTHA* (S. LAT.).

The nonmetric MDS ordination of *Lomandra micrantha* in two dimensions provides a useful simplification of the data with five groups discernible. The scatter diagram (eigenvector 1 versus eigenvector 2) of the MDS analysis, with the overall stress reduced to 0.1611, is presented in Figure 1. The five groups distinguished by the MDS analysis include: *L. micrantha* subsp. *micrantha* s. str. (here referred to as '*micrantha* 1'), *L. micrantha* subsp. *micrantha* ('*micrantha* 2'), *L. micrantha* subsp. *teretifolia*, *L. micrantha* subsp. *tuberculata* and *L. oreophila* (formerly *L. micrantha* var. *sororia*). The vectors showing the direction of maximum linear correlation between each of the characters and the MDS ordination space are illustrated in Figure 2. The cluster analysis of the specimens (Fig. 3 — simplified by truncation at the five-group level) also supports the groupings derived from the MDS analysis.

The morphological variation of the specimens within *L. micrantha* (s. str. — without *L. oreophila*) was further investigated using clustering and ordination analyses as described above. Male and female plants were also analysed separately, particularly because male inflorescences are usually longer than female inflorescences. Although not presented here, these analyses supported the groupings obtained from the full data (refer Figs 1 & 3) without offering further infraspecific resolution. The '*micrantha* 2' subgroup was recognised in all analyses.

## TAXONOMIC CONCLUSIONS

Bentham suggested that *Xerotes micrantha* var. *sororia* F. Muell. ex Benth. (*Lomandra micrantha* var. *sororia* (F. Muell. ex Benth.) H. Williamson) was 'perhaps a distinct species' from *X. micrantha* s. str. (Bentham 1878, p. 103). The collections representing *Lomandra micrantha* var. *sororia* can be distinguished readily from the remainder of *L. micrantha* (Figs 1 & 3), and are sufficiently distinct to be recognised as a species (*L. oreophila*) separate from *L. micrantha* (s. str.). The reduction of this taxon by Everett (1986) to synonymy under *L. micrantha* subsp. *tuberculata* is not supported by our work (refer Figs 1 & 3). Based upon the characters used, *L. oreophila* and *L. micrantha* subsp. *tuberculata* are the most dissimilar taxa in this study. Although not included in this analysis, the affinities of *L. oreophila* are more likely to be with *L. drummondii* (refer 'Relationships' under *L. oreophila*). *Lomandra oreophila* is characterised by the following features: the leaves are flat (leaf shape variable:  $r = 0.655$ ;  $V = 0.843$ ), whereas the leaves of *L. micrantha* vary from terete to concavo-convex; the leaves are generally wider than *L. micrantha* (leaf width:  $r = 0.738$ ;  $V = 0.864$ ); the leaves are not twisted, whereas those of *L. micrantha* are, often strongly so (leaf twist:  $r = 0.917$ ;  $V = 0.949$ ); the scape is tuberculate (a character state shared with

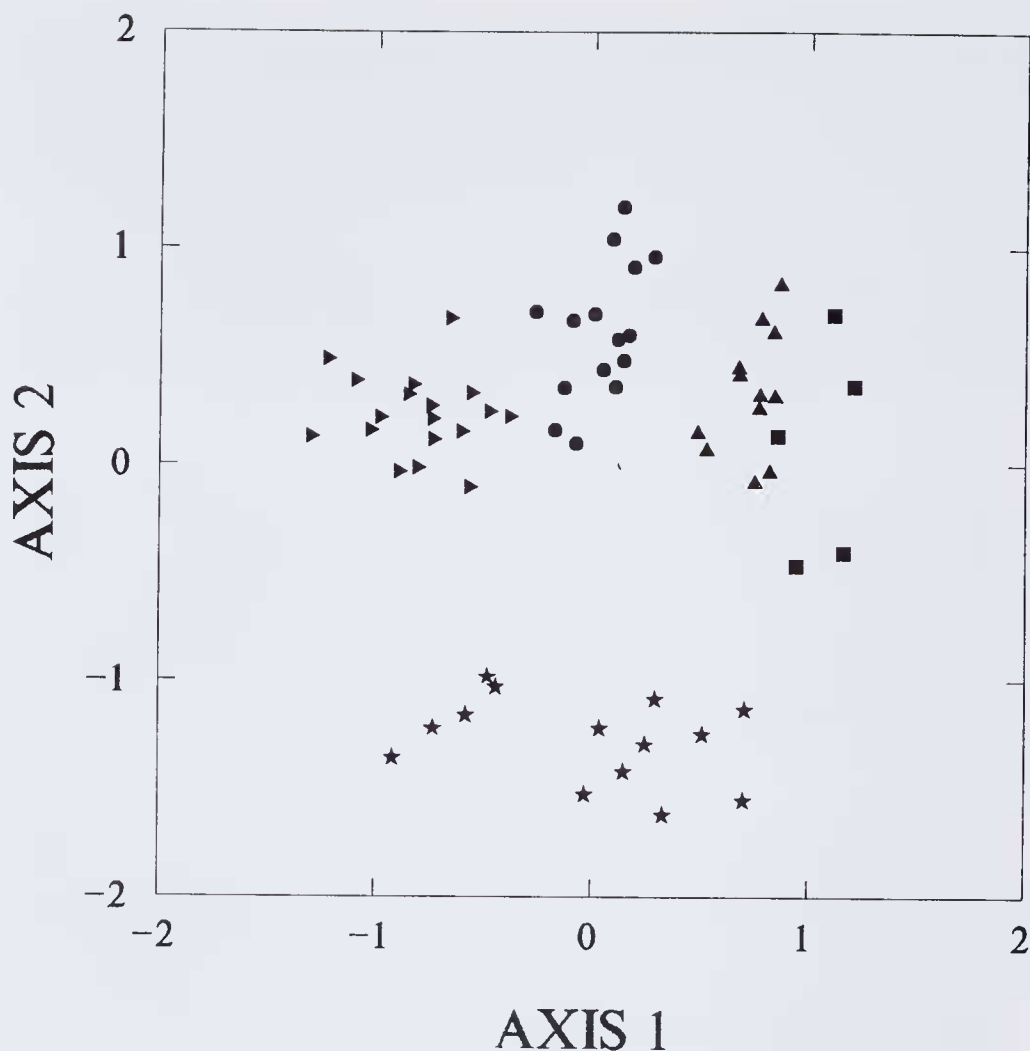


Fig. 1. Morphometric analysis of *Lomandra micrantha* s. lat.: scatter plot of individuals on the first two eigenvectors from a non-metric Multidimensional Scaling (MDS) ordination derived from Gower metric association matrix. Symbols: *Lomandra micrantha* subsp. *micrantha* ('*micrantha 1*') (▲); *L. micrantha* subsp. *micrantha* ('*micrantha 2*') (●); *L. micrantha* subsp. *teretifolia* (■); *L. micrantha* subsp. *tuberculata* (►); *L. oreophila* (★).

*L. micrantha* subsp. *tuberculata*), whereas the other taxa are either smooth (lacking projections) or papillate (inflorescence surface projections:  $r = 0.858$ ;  $V = 0.880$ ); and the scape is usually hidden by the bases of the leaves (a character state shared with *L. micrantha* subsp. *micrantha* ('*micrantha 1*') and subsp. *teretifolia*), whereas it is usually extended beyond the leaf bases in *L. micrantha* subsp. *micrantha* ('*micrantha 2*') and subsp. *tuberculata* (scape:  $r = 0.879$ ;  $V = 0.890$ ).

The investigation of the morphological variation within *L. micrantha* (excluding *L. oreophila*) revealed two main groups: (1) '*tuberculata*', and (2) '*teretifolia/micrantha*'. The '*tuberculata*' group is equivalent to *L. micrantha* subsp. *tuberculata* (excluding *L. oreophila*). It is characterised by the following features: scapes tuberculate and scape exposed (refer discussion of *L. oreophila* above); and inflorescence axis with projections usually larger than for the other taxa (except those of *L. oreophila* become as large) ( $r = 0.789$ ;  $V = 0.850$ ).



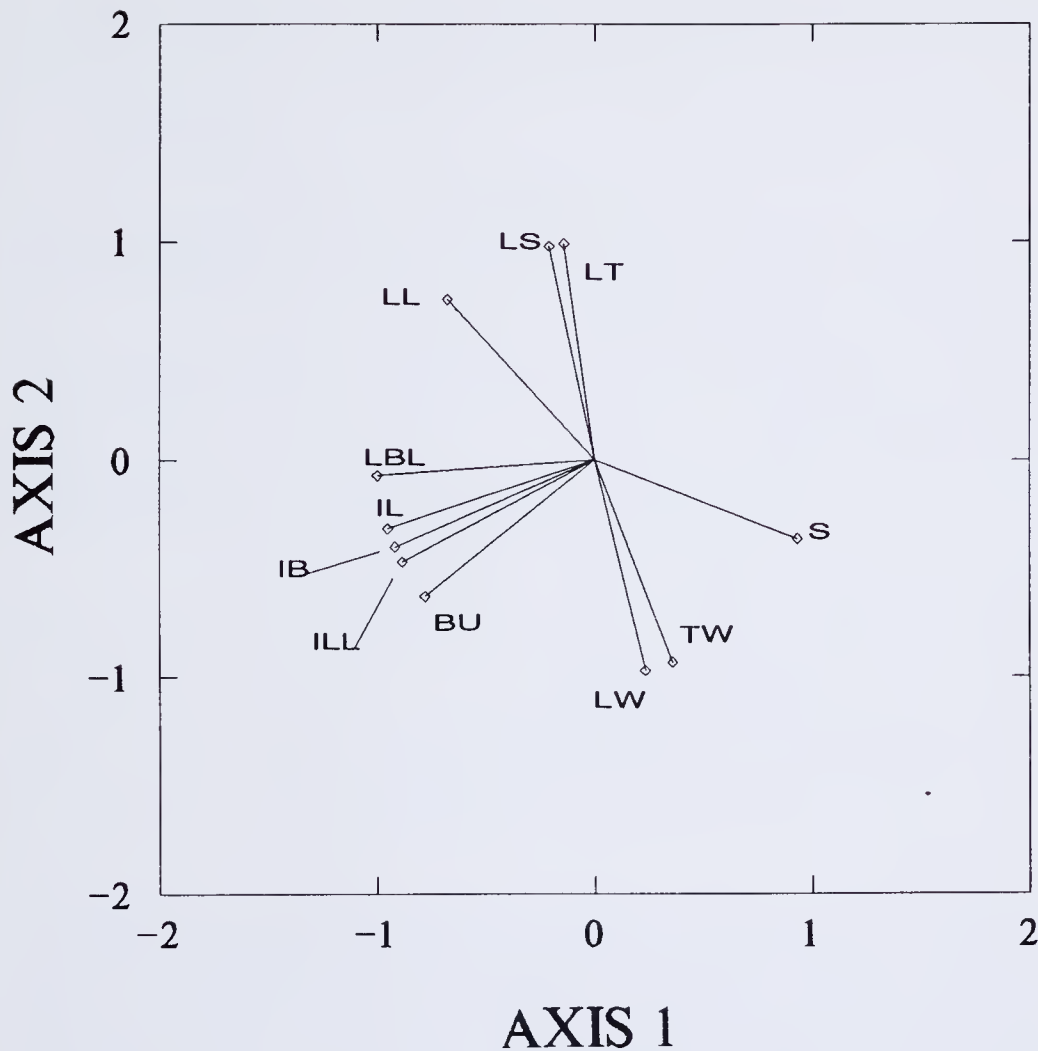


Fig. 2. Vectors showing direction of maximum linear correlation between each of the eleven characters and the MDS ordination space. Character name abbreviations are those listed in the 'Methods & presentation' section.

Our study suggests that the '*teretifolia/micrantha*' group consists of two subgroups: one comprising '*teretifolia*' and '*micrantha 1*'; and the other '*micrantha 2*'. However, we believe that it would be premature to recognise these subgroups formally as defined by the morphological characters used in this study. It is believed that the interpretation of some characters may have blurred the distinction between '*teretifolia*' and '*micrantha 1*'. For example, although the semi-terete leaves of '*micrantha 1*' are morphologically indistinguishable from those of '*teretifolia*', a preliminary investigation of the leaf anatomy of *L. micrantha* (*s. lat.*) suggests that they are not homologous. It appears that subsp. *teretifolia* (as defined here) is probably not closely related to *L. micrantha* (*s. str.*).

The '*teretifolia*' part of the first subgroup is equivalent to *L. micrantha* subsp. *teretifolia* (as defined in this paper). It is characterised by having longer and broader semi-terete to terete leaves (leaf length:  $r = 0.086$ ;  $V = 0.541$ ; leaf width:  $r = 0.738$ ;  $V = 0.864$ ). The inflorescence length to leaf length ratio for subsp. *teretifolia* tends to be smaller than for '*micrantha 1*' and '*micrantha 2*' ( $r = 0.749$ ;

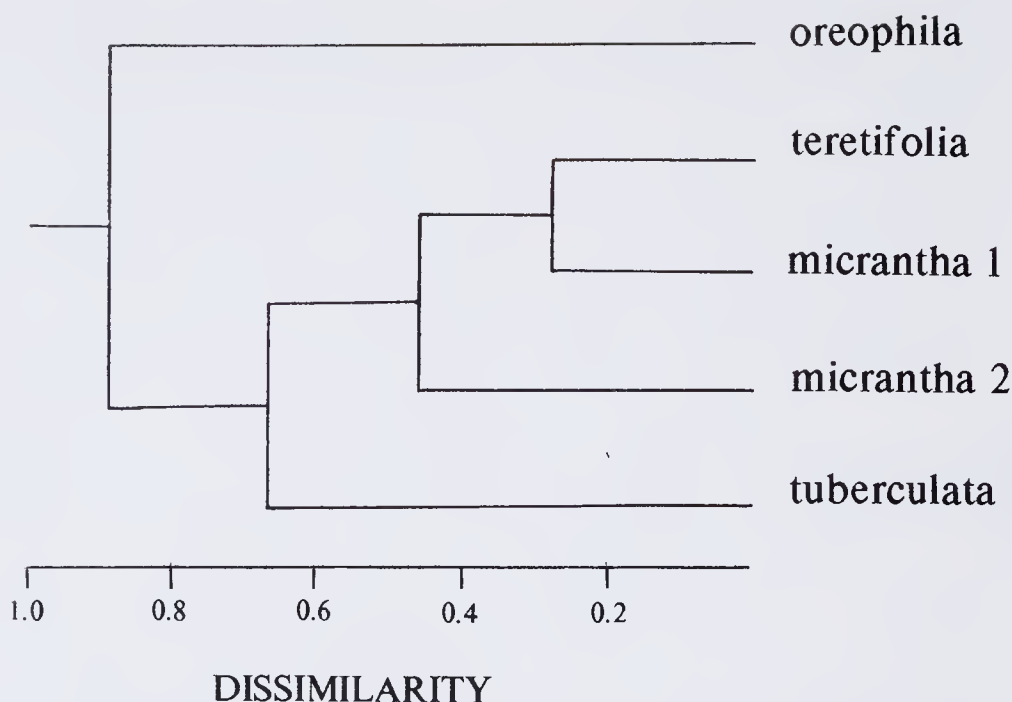


Fig. 3. Cluster analysis (UPGMA) of morphometric variation in *Lomandra micrantha* s. lat., simplified by truncation at the five-group level.

$V = 0.636$ ). That is, the inflorescence of subsp. *teretifolia* tends to be much shorter than leaves.

The recognition of two '*micrantha*' groups was unexpected, especially since the analyses suggest that '*micrantha 1*' is more similar to subsp. *teretifolia* than to '*micrantha 2*'. The differences between these two '*micrantha*' groups appear to be slight, but the additive effect results in the analyses recognizing them as distinct. When compared to the '*micrantha 2*' group, the '*micrantha 1*' group (= *L. micrantha* subsp. *micrantha*) has slightly shorter, narrower leaves, with slightly shorter leaf bases, and slightly shorter inflorescences. The scape is generally hidden in '*micrantha 1*' and exposed in '*micrantha 2*'. The '*micrantha 2*' group consists of Western Australian collections, plus one Victorian collection (*Willis s.n.*, MEL 20869a & b) that have been identified by some botanists as belonging either to *L. micrantha* subsp. *micrantha* or to subsp. *teretifolia*. Further work is required to evaluate the status of the '*micrantha 2*' group.

The broad subspecific circumscription generally applied to subsp. *teretifolia* is not supported by this study. We conclude that much of the material currently identified as subsp. *teretifolia* is better placed in subsp. *micrantha* (both the '*micrantha 1*' and '*micrantha 2*' groups). Subspecies *teretifolia* does not occur in Victoria, but is restricted to Western Australia. The taxonomic status of *Lomandra micrantha* subsp. *micrantha* ('*micrantha 1*' and '*micrantha 2*') is unclear, and further study is required to clarify the '*teretifolia/micrantha*' group.

Although, the morphological characters used were not sufficiently 'robust' to clarify completely the taxonomic status of the taxa in *L. micrantha* (s. lat.), several conclusions are possible. (1) *Lomandra oreophila* is a species distinct from *L. micrantha* (2) the currently recognised subspecies of *L. micrantha* are supported, except that (a) subsp. *tuberculata* should be redefined to exclude the taxon here treated as *L. oreophila*; (b) a narrower circumscription of subsp. *teretifolia* is necessary as the current definition includes part of subsp. *micrantha* s. str. (here

referred to as '*micrantha* 1') and part of the '*micrantha* 2' group; and (c) an additional subgroup (viz. '*micrantha* 2' group) suggests that redefinition of the subspecific taxa of *L. micrantha* may be necessary.

#### CIRCUMSCRIPTION OF *LOMANDRA OREOPHILA*

*Lomandra oreophila* Conn & Quirico *nom. & stat. nov.*

**BASIONYM:** *Xerotes micrantha* var. *sororia* F. Muell. ex Benth., *Fl. Austral.* 7: 103 (1878); *Lomandra micrantha* var. *sororia* (F. Muell. ex Benth.) H. Williamson, *Victorian Naturalist* 45: 37 (1928). **LECTOTYPE (here chosen):** Victoria (East Gippsland), 'Xerotes laxa R. Br.' 'Mount Wellington, Gipps Land' [in Mueller's hand], *F. Mueller s.n.*, [Nov 1854] (K); **ISOLECTO:** 'Xerotes micrantha Endl. var. *sororia*' 'Mount Wellington, Gippsland' [on 'Phytologic Museum of Victoria' label, in Mueller's hand], *F. Mueller s.n.*, [Nov 1854] (K); probable **ISOLECTO:** 'In montibus subalpinis . . . prope montum Wellington' [in Mueller's hand], 'Gippsland alps, about 4000' [feet] high', *F. Mueller s.n.*, Nov [18]54 (MEL 20866), 'Lower part of Mount Wellington, Gipps Land' [probably written by C. Wilhelm], *F. Mueller s.n.*, [Nov 1854] (MEL 20867) (refer Typification).

*Leaves* stiff and erect, 250–500 mm long, (2.5–)3.3–4(–5.5) mm wide, glabrous, flat with margin usually  $\pm$  incurved, or slightly concavo-convex (in cross-section), not twisted; margin with a conspicuous marginal zone; basal sheath with margin intact or occasionally slightly torn, 45–60 mm long; apex rounded to almost truncate, or with two lateral teeth (often caused by ageing of apex) (see Notes). *Inflorescence* (0.2–)0.3–0.5(–0.7) times as long as leaves with non-flowering axis (scape) hidden or exposed; axes conspicuously covered with tubercles 0.04–0.08 mm long. *Male and female inflorescences* similar; male inflorescences 14–30 cm long; female inflorescences 7–21 long. *Male flowers* with tepals 1.9–2.6 mm long; *female flowers* with tepals 3–4.5 mm long. *Fruit* ovoid, c. 3 mm diameter, pale brown. (Fig. 3)

#### TIPIFICATION

Everett & Lee (determinavit slips) concluded that the type material of this species (viz. *Xerotes micrantha* var. *sororia* F. Muell. ex Benth.) was held at MEL and regarded MEL 20866 as the holotype and MEL 20867 the isotype. This view was followed by Lee and Macfarlane (1986). Whether Bentham actually examined these specimens is not known, but two herbarium sheets of this taxon are held at K in the Hooker Herbarium. These are best considered as type material and the lower right specimen on the sheet with 'Xerotes laxa R. Br.' 'Mount Wellington Gipps Land' 'Dr ferd. Mueller' [in Mueller's hand] is here chosen as the lectotype. The other two specimens on this sheet and the specimen on the other sheet are here regarded as isolectotypes. The material held at MEL is here regarded as probable isolectotypes.

#### NOMENCLATURE

With the status of this taxon being raised to specific level, the epithet '*sororia*' can not be used because the new combination (*L. sororia*) would be a later homonym of *L. sororia* (F. Muell. ex Benth.) Ewart. Therefore, the new name *L. oreophila* based on the type of *Xerotes micrantha* Endl. var. *sororia* F. Muell. ex Benth. (as discussed above) is here proposed.

#### OTHER SPECIMENS EXAMINED

**Victoria — Eastern Highlands:** Moroka Range, 2 Nov. 1973, *Beaglehole* 43470 (MEL 1515703); 2.2 km NW of confluence [sic] of O'Keefe Gully and Aberfeldy Road, near Aberfeldy, 18 Oct. 1978, *Walsh* 161 (MEL 547912). **Snowfields:** Mt Howitt, 5 km SSE of Mt McDonald, 17 Jan. 1973, *Beaglehole* 41219 (MEL 1515700); Mt Useful, Natural Feature — Scenic Reserve, 25 Apr. 1985, *Beaglehole* 79278 (MEL 682530); Mt Skene, 24 Feb. 1949, *Willis s.n.* (MEL 20868). **East**

Gippsland: Mt Tingaringy, 24 Oct. 1973, *Beaglehole* 43409 & 43410 (MEL 1515701 & 1515702); Mt Tower, 6 Oct. 1984, *Cheal* s.n. (MEL 1563395); Upper Rodger River, 21 Feb. 1983, *Chesterfield* s.n., (MEL 626304).

#### DISTRIBUTION

Endemic to Victoria (Eastern Highlands, Snowfields, East Gippsland)(Fig. 5).

#### HABITAT

This species occurs in alpine and subalpine *Eucalyptus pauciflora* and *E. dives* Woodlands.

#### CONSERVATION STATUS

The conservation status of this species is not known.

#### NOTES

Although the leaf apex is usually rounded (Fig. 4b) to almost truncate, older leaves are often irregularly two-toothed (Fig. 4a). This is unexpected because two-toothed apices are characteristic of the *L. longifolia* Labill. group, *L. rigida* Labill. and *L. effusa* (Lindley) Ewart, rather than the *L. micrantha* group. However, the two lateral teeth of the leaves of this latter group are irregularly formed as part of an aging process.

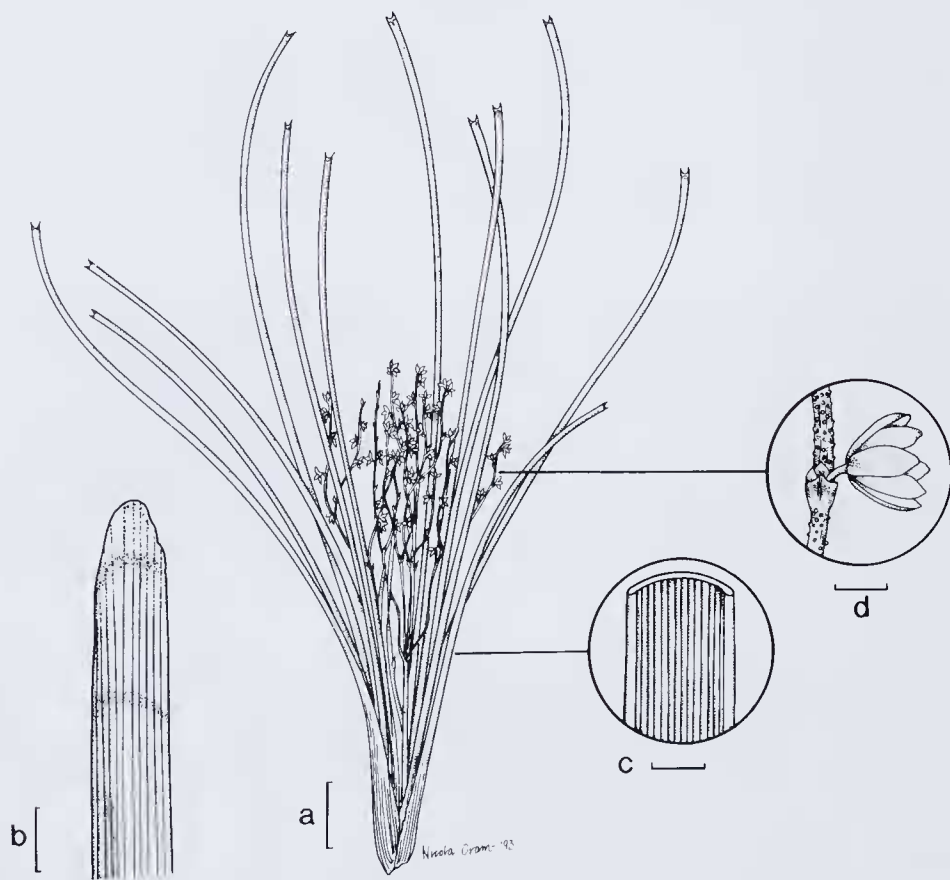


Fig. 4. *Lomandra oreophila* a — habit of female plant showing leaves and inflorescence (Note: leaf apex with two lateral teeth due to aging). b — detail of rounded leaf apex. c — detail of leaf surface and leaf shape. d — female flowers and detail of tuberculate inflorescence axis. (a, c & d *Beaglehole* 43409; b *Beaglehole* 43470). Scale bar: a = 3 cm; b = 5 cm; c & d = 1.5 mm.



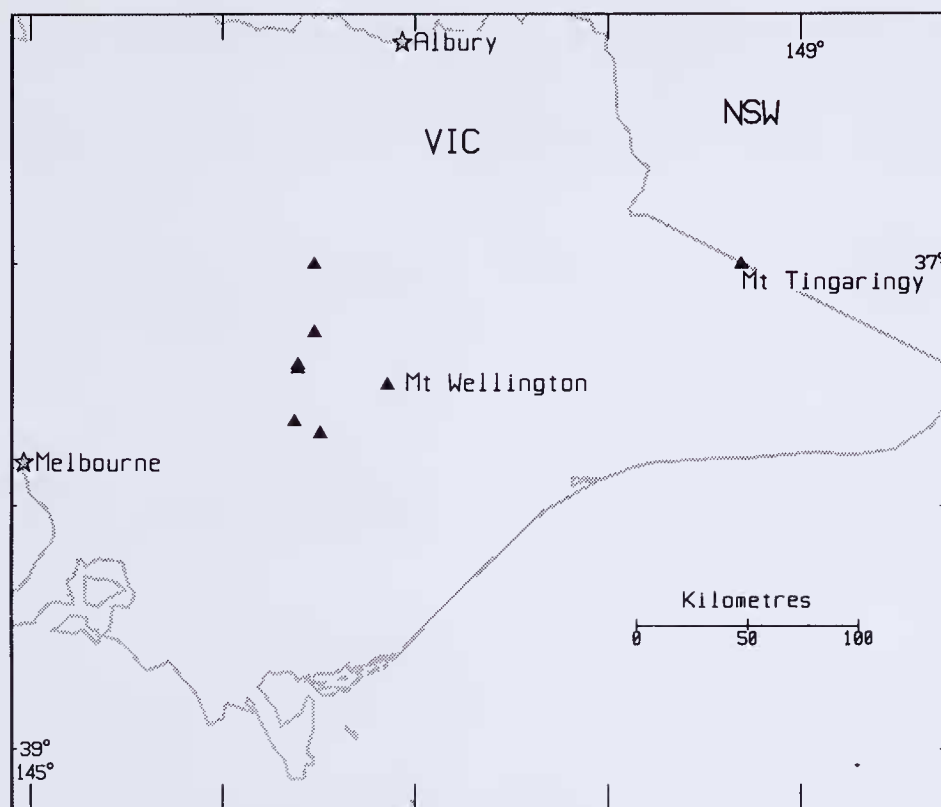


Fig. 5. Distribution map of *Lomandra oreophila* in Victoria, Australia.

#### RELATIONSHIPS

The affinities of this species appear to be with *L. drummondii* (F. Muell. ex Benth.) Ewart. Considering all the species of *Lomandra* section *Lomandra* series *Sparsiflorae* (Benth.) A. Lee, the relatively broad leaves of *L. oreophila* are reminiscent of *L. drummondii* of south-western Western Australia and *L. laxa* (R. Br.) A. Lee of coastal eastern Australia. *Lomandra drummondii* and *L. oreophila* share many features in common. Both species have male flowers with similar sepals and petals; both have male and female inflorescences that are similar and shorter than the leaves; both have a conspicuous marginal zone on the leaves and more or less rounded leaf apices. The most distinctive difference between these two species is that the axes of the inflorescence are warty in *L. oreophila*, whereas they are papillose (scaberulous, *sensu* Lee & Macfarlane 1986) in *L. drummondii*. Furthermore, although the papillae of *L. drummondii* are often as large (up to 0.07 mm long) as the tubercles of *L. oreophila*, they are usually substantially shorter (0.01–0.02 mm long).

*Lomandra laxa* has several features that are different from *L. oreophila* and these two species are not regarded as closely related. One of the more important differences is that the male sepals of *L. laxa* differ from the petals, whereas they are similar in *L. oreophila*. The former species also differs by having a creamy-white perianth, whereas *L. oreophila* has flowers with greenish-yellow to dark reddish sepals and petals.

#### ETYMOLOGY

The specific epithet, '*oreophila*' refers to the preference for this species to occur in the mountainous regions of eastern Victoria.

KEY TO TAXA OF THE *LOMANDRA MICRANTHA* COMPLEX

In the 'Key to species' of the genus in the *Flora of Australia* account (Lee & Macfarlane 1986), *Lomandra oreophila* is included under *L. micrantha*. The following key distinguishes this species from the subspecies of *L. micrantha*. Since we believe that it is premature to recognise formally the '*micrantha* 1' taxon from '*micrantha* 2', these two are included in *L. micrantha* subsp. *micrantha* until the *teretifolia/micrantha* group is clarified (refer 'Taxonomic conclusions', above).

- 1 Inflorescence axes conspicuously covered with wart-like projections
  - 2 Leaves flat, not twisted, often with margin incurved, or slightly concavo-convex, (2.5-)3.3-4(-5.5) mm wide..... ***Lomandra oreophila***
  - 2: Leaves semi-circular (in cross-section), or concavo-convex to folded (in cross-section), gently twisted longitudinally, (0.8-)1-2(-2.5) mm wide.....  
..... ***Lomandra micrantha* subsp. *tuberculata***
- 1: Inflorescence axes smooth or papillose to minutely scabrid
  - 3 Leaves semi-circular or transversely narrow-elliptic (in cross-section), or flat, (0.4-)0.8-2(-2.5) mm wide, or if less than 0.6 mm wide then subterete,  $\pm$  firm, but never rigid..... ***Lomandra micrantha* subsp. *micrantha***
  - 3: Leaves terete, c. 3.5-4 mm diameter, rigid .....  
..... ***Lomandra micrantha* subsp. *teretifolia***

## ACKNOWLEDGEMENTS

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